CHAPTER 9: FINDINGS AND CONCLUSIONS

While this joint use project has a defined beginning and end, the investigation and application of joint use feasibility is a continuously evolving process.

9.1 REVISITING THE PROBLEM STATEMENT

The study team came to some conclusions as the research advanced regarding the study effort itself which may assist future research. The problem statement, as the title of the project indicates, emphasized *"light rail and diesel multiple unit vehicles on freight railroads."* As the research progressed, the key issues (Chapter 5) broadened the emphasis to include ***all rail transit on all railroads.*** "All rail transit" included all non-compliant railbuses, rapid transit and interurban type operations, and rolling stock, as well as light rail and DMU vehicles of various types that could potentially operate jointly. The key issues better defined the two regulatory areas of rail transit and railroads. This definition was reinforced by European experience and the changing U.S. regulatory climate where rail transit and railroads are regulated in distinctly different ways.

The expansion of the research was to include the Pacific Rim in the overseas experience. This proved more important than first imagined, because the Japanese experience indicates a greater integration of different rail modes to the extent that they begin to lose their separate identities. There, joint use is practiced so routinely and diversely that shared track is not considered an exception to the rule.

9.2 REVISITING THE KEY ISSUES

An early objective of this research was to identify key issues relating to joint use. This was accomplished and documented in Chapters 1-4, culminating in Key Issues, Chapter 5. Finally, the key issues were to be addressed in Chapter 9, Conclusions. Key issues were structured around the four foundations of joint use debate:

- Regulation/policy,
- Operations,
- Physical plant, and
- Vehicles.

1. Key Regulation Issues

a. Is joint use a sound policy worth Advancing?

The research discloses that rail passenger travel is inherently safer than vehicular modes. Rail transit suffers a fatality rate of 0.73 for rapid transit, 0.38 for commuter rail and 0.25 for LRT per hundred million passenger miles. In contrast, the vehicular rate is 1.44 fatalities per hundred million passenger miles (E. Tennyson, "Rail Transit Safety Analysis," TRB, 1998). This alone is not sufficient reason to justify shared track on a national basis. Other risk assessment and alternative investment analysis should be performed fully to justify decisions in support of shared track between railroads and rail transit.

In Europe and Japan, those type of decisions are traditionally made at local, metropolitan, or state levels and on a project-by-project basis. The Federal role in the U.S. and Europe is to develop a regulatory framework which establishes baseline standards to be applied locally and to oversee the enforcement of those standards. That arrangement and respective roles are not dissimilar from the North American experience. They differ only in specific applications and split of regulatory roles.

The research team found nothing to suggest that the current procedure of FRA issuing temporary waivers for non-compliant rolling stock and circumstances should not be continued when sufficient justification is offered and safety measures are enforced. Similarly, the FRA's increasing use of safety risk assessment in joint track use proposals (high speed passenger with freight, exemplified by FOX and Northeast Corridor electrification extension projects) follows a similar process used by the German Ministry of Railways five years ago. The difference is that the German assessment was for running Regio-Sprinter DMUs in mixed freight and passenger traffic at Düren and Chemnitz, while the FRA application was for slow and high speed passenger railroad on shared facilities. All of this evidence suggests that shared track and joint use are already being addressed with similar methodologies (as a matter of FRA policy), but not in the same applications.

b. What risk mitigations can be applied to joint use to reduce risk to tolerable levels?

The crashworthiness vs. crash avoidance issue applies in selecting mitigation measures to reduce risk. The cooperative PTC and PTS demonstrations and experiments are currently addressing this in part, but the results are not available. [Refer to Appendix M, "Special Conditions for Operation of LRVs...". Speed, braking distance, isolation of switching, operating discipline, and practices, combined in passive (vehicle design) measures are the principal mitigation measures used effectively. See also key issue 1d in this chapter.]

c. Does joint use constitute a hazard to public safety?

This oversimplified statement of a key issue cannot be answered absolutely with "yes" or "no." Related questions have been answered by this research. Is joint use more hazardous than running homogeneous train consists together? Yes, it is more hazardous, but the degree of hazard may not be significant, may be tolerable by the shared track partners and that hazard which exists may be reduced by mitigation measures to the point where it meets or exceeds the safety of homogenous train consists on the same track. The following points support these assertions:

- No major accidents have occurred in overseas joint use applications over the decade that they have existed. Meanwhile, during the same period, some significant losses of life have been experienced abroad and in North America by collisions between train consists of the same type (note - Appendix N).

- Data collected from risk analysis performed for German railroads, using the same risk analysis technique as those used for FRA (in evaluating high speed vs. freight train shared track mixes), indicate tolerable levels of risk. The German risk analysis was performed for light DMUs, such as used in Chemnitz and Düren, and for LRVs, such as used in Karlsruhe and Saarbrücken (Appendix N).

- Rail transit and railroad passenger travel are inherently safer than other surface travel modes.

d. What are the quantifiable risks and liabilities arising from various degrees of joint use?

Currently the only railroad/rail transit mitigation measure employed in North America is temporal separation of train movements. This control measure reduces shared track risk to zero by totally separating railroad and rail transit movements. Freight trains have a three-to-five hour window after late night closure of light rail operations and prior to resumption of LRT operations in the morning. This restricts freight service to shippers and reduces opportunities to perform track and infrastructure maintenance because of the lack of routine total shutdown during night hours.

The German Railway Ministry, following their risk analysis findings, determined that several mitigation risk controls would diminish joint use risk to acceptable levels for all participants (see also Appendices M and N) in German joint use operations:

- Limit speed of train operations on shared track to 90 km/h (55 mph). This speed limit was based on the enhanced braking capabilities of LRVs, that is, their ability to avoid collisions through reduced stopping distances. As pointed out earlier, 80% of (German) rail collisions are caused by an inability to stop in time. The limit in speed, combined with the high-performance redundant braking system inherent in LRVs (to enable them to travel in mixed vehicular and pedestrian traffic), diminish risk. This maximum speed can be increased to 100 kph (62 mph) if certain ISO 9000 standards are followed. Since most LRVs do not exceed 50-55 mph balanced speed, this type of mitigation can be easily applied in the U.S.

- Prohibit railroad switching operations on track used concurrently with LRTs. Again, the risk analysis disclosed high vulnerability to collisions with switching operations because of highly intermittent track occupancy, as long durations of track occupancy occurred by freights leaving their train on running tracks while switching cars onto sidings and spurs. Note that this requirement does not prohibit through (nonstop) freight trains traveling in the same direction. This control measure can also be applied, but at the increased capital costs of additional tracks to permit switching without interference to LRVs.

- Speed and other restrictions are applied more rigorously with single track (with passing sidings). Risk control standards in the German experience change as risk increases. Specific mitigation measures are imposed, then applied on a sliding scale to intensify control measures consistent with increases in risk from higher speed or greater train density. RA dictates the scale.

- Apply train control technologies. Train protection systems are required for routes with joint operation. The type and degree of protection depends on maximum permissive speed, types of train consists, train performance (principally stopping distance), and the volume of trains. Specific mitigation using train control, signal spacing, and braking distances are specifically applied to each case.

- Wheel tread profile conformity. This is somewhat less of a mitigation and more of an operational requirement. In Germany, a compromise profile was developed enabling Karlsruhe LRVs in Stadtbahn service to transition between in-street train rail and railroad track (Figure 7-1).

- Rail transit and railroad vehicles may not be coupled into the same consists if the light rail vehicle has a buffing strength of less than 1500 kN (335,000 lbs.). This creates a threshold for DMUs principally and applies less to LRVs. It is intended to clearly distinguish among railroad trains, LRVs, and DMUs, the latter of which would be most likely to be coupled with railroad rolling stock or dual service branch line railways.

The most recent light (Category 2 or 3) DMUs produced for the Western European markets are designed to these buffing requirements.

e. Can regulation of rail transit be assumed (wholly or in part) by state and regional entities?

The German joint use experience in regulatory matters is instructive. It indicates that the concept of shared track was accepted more by *changes in the application of regulations than by changes in the specific standards or requirements.* German decisions on permitting permanent joint use agreements were initiated by the German Railway Ministry (a rough equivalent of FRA). Their decisions favoring joint use, with conditions, were based on a process initiated by the Karlsruhe proposal and later by the Düren DMU shared-track proposals. Both generated specific risk analyses of a conventional nature described in Chapter 6 and Appendix N. The ministry's decisions were conditioned on imposing compensating risk requirements, such as the substitution of active for passive risk mitigations. Example: To compensate for the lighter LRV where its passive safety (crashworthiness) is inferior to railroad trains, higher active safety (avoidance of collisions) had to be substituted.

The primary mitigation rationale was to apply the reduced stopping distances of LRVs combined with a reduced permissive speed of 100 km/h and improved signal spacing, upgrading, and better communication. Not reported, but also deciding factors, were a strong local will and reliance on a firm operating discipline to implement shared track operations. This report suggests that the German example represents an approach to reconciling various contrasting interests on the subject of shared track, trading off forms of safety measures for others. In summary, this process involved:

- Scoping the specific joint use proposal,
- Collecting data on operations and accidents,
- Performing a Risk Analysis and making a preliminary go/no-go decision,
- Determining probabilities and appropriate risk mitigation measures to apply,
- Performing a series of controlled tests (as in the pre-service Pforzheim tests in Karlsruhe),
- Applying for permanent waiver or exception,
- Beginning service.

Note that this technique is not applied to joint use in Japan, where decisions are more a product of joint venture business decisions and applying for operating licenses.

This does not suggest that standards should be relaxed or that German regulations are more lenient or less complex than those in North America. In fact, as pointed out in Chapter 7, in addition to federal railroad (EBO) regulations comparable to those of FRA, *German streetcar/rail transit is governed by stringent standards and regulations (BOStrab) for which there are no direct equivalents now in the U.S. North American rail transit standards, regulations, and safety plans are being created by state regulatory authorities for the purpose of developing statewide System Safety Program Plans.*

2. Key Operational Issues

a. What elements of overseas joint use experience and operation practices can be transferred to the North American rail transit and railroad environment?

Rather than transferring overseas operating practices wholesale to North America, selected lessons can be learned and applied from the growing wealth of shared track experience.

In contrast to European experience, shared track in Japan most commonly appears in the form of reciprocal running or "through running." There, two or more carriers share portions of their track networks as zoned but integrated service. While heavy rail rapid transit, interurban, and railroad shared track is relatively uncommon in continental Europe, it appears as one of the most familiar forms of reciprocal running in Japan and Korea. Light rail operating on railroad tracks, however, is relatively uncommon in Japan, but is becoming a European standard based on Karlsruhe and an increasing number of other models. Because rail freight is so subordinated to passenger service in Japan, shared track, where practiced, most often occurs between *passenger* railroads and rail transit operators. This enhances the popularity of shared track between operators because both the operations *and the services* can be integrated in a common timetable. Services can be zoned and other complementary benefits can accrue to passenger and operator. No such operating benefit derives from shared track between freight and passenger carriers, regardless of rail mode.

Some overseas experience may be instructive but is otherwise not transferable. In the U.S., the metropolitan areas, even those in the northeast, are distantly separated and the interurban links that may have existed have disappeared. The types of connecting rail linkages found in Japan are unlikely to be restored in the U.S. even if joint use practices are accepted. The standards and distances vary too much to permit the common subway-railroad-subway model found in Japan. The North American situation is one of widely separated local rail transit systems, having little in common with those of neighboring metropolitan areas, and in some cases, little in common with other lines within their own system under common ownership. The possibility for some through running operations does exist among disparate rail systems; one has recently come to light.

The close proximity of metro areas in Japan, but contrasting physical standards, has resulted in an important feature in the *evolution* of shared track arrangements; a hybrid car, purpose-built to migrate between otherwise incompatible rail transit systems. This is similar to the recently approved JFK Airport Light Rail Transit Project. It is designed to a light rail dimensional standard (but automated and using linear induction motors fed from conventional DC third rail). Designed as a large dual-rail people-mover-type operation on airport distribution functions, the system ventures off the airport to line haul connect with the Long Island Rail Road and NYCT rapid transit systems at separate locations. Because of the varying dimensional, operating (automated vs. non-automated), and propulsion (LM vs. rotary traction motors), and institutional problems of crossing operational domains, interchange of rolling stock and joint use is now impossible. Passengers will initially have to transfer. Confident that some day the institutional problems of interchange can be resolved, the operator of the airport designed its rail system so as not to preclude through running, but not reciprocity, using a future hybrid car that can operate on the airport system and then switch to either the rapid transit or LIRR tracks to access midtown Manhattan.

3. Key Physical Plant and Train Control Issues

a. What fail-safe signaling and train control technologies are applied in collision avoidance?

Train control technologies are being developed and tested for several important reasons:

- To improve the already good safety record of rail transit and railroad operations here and abroad.

- To leverage additional capacity from rail infrastructure by closer spacing of train movements.

- Accompanied by risk analysis, these technologies are also being applied to proposals for sharing tracks by high-speed passenger and freight railroad trains.

All of these applications by Federal, state, railroad, technology vendors and railroad sponsors are useful in enhancing the viability of joint use practices, regardless of train types participating in the track sharing. The issue revealed in the third item above is, if 60 mph freight trains can safely operate with 150 mph passenger trains using advanced train control technology on shared track to reduce risk, why cannot the same be applied to heavy (railroad) and light (rail transit) train consists, both going a maximum of 60 mph on shared track? Both would operate within the same fail-safe train control and operating regimen. It is a matter of risk exposure and agreement between the railroad and transit entities regarding cost and liability, which are not insignificant issues. This approach of evaluating risk of two very different types of trains sharing tracks is currently considered valid in one case but not in the other similar case.

This research suggests that PTS, PTC, and other train control and separation technologies can be applied to validating selected mixed use by railroad and rail transit vehicles. This is an area where further research and testing is appropriate to determine if PTS train detection and positioning can be applied to the very high density train operations found in rail transit.

4. Key Rail Vehicle Issues

a. Which crashworthiness measures can be applied to DMU or LRV designs as risk mitigations?

A debate among practitioners continues on mixing disparate size and weight vehicles and on the relative effectiveness of active and passive approaches to passenger and crew safety. Only a risk assessment applied in each operating case will ultimately determine which of these measures or combination of measures is most effective. Risk assessment is therefore the keystone to this research and at the center of its conclusions relating to joint use proposals.

Some attempts are being made to include both crashworthiness and crash avoidance type measures in new light rail car designs. These designs by European-based car builders are in response to the new market for regional railways and possible other applications of joint use/shared track. Contemporary trams and light rail vehicles in Europe typically fall in the range of 20 to 40 tonnes (44,000-88,000 lbs) buffing strength. The North American buff design practice is nearer to 150% to 200% of the tare weight of the (single) vehicle. This is often referred to as the "2g" spec or a longitudinal compression equal to twice the weight of the LRV. The Portland low floor LRV buff load specification is a little under 80 tonnes (>160,000 lbs). The North American LRV range exceeds that of its European counterpart by a factor of two or more. The North American LRV buffing load range is 40-100 tonnes (88,000-200,00 lbs.). Further up on the scale, modern European light rail DMUs are now designed to withstand nearly 350,000 lbs (50kN). Crush zones, impact attenuation, and debris deflection devices are incorporated in the designs of these cars, which are operating on railroads through western Europe (see Figure 9-1). These are of a *passive nature*, that is, they pertain more to the design of the vehicle than the operating performance (*active nature*). These cars still retain their active safety performance characteristics through use of multiple disk, tread, or track brakes, and regenerative or retarder systems. The U.S. railroad standard is currently 800,000 lbs. buff load, except for light cars in reduced fixed consists.

5. Comprehensive Issues

a. Crashworthiness vs. crash avoidance can some measure of both be applied to mitigate risk?

There are two basic approaches to rail accident risk: active (crash avoidance) and passive (crashworthiness). The passive measures are designed to prevent injury, fatality, or damage in a collision. The active measures are designed to avoid collision in the first instance. These two methods of dealing with risk are seldom complementary. In plain terms, the heavier the vehicle is to withstand impact, the longer the braking distance required to avoid a collision. European regulators now tend to embrace active safety measures or a combination of active and passive, whereas North American regulators currently require passive measures. This is partly due to German regulators' scope covering rail transit (BOStrab) and railway (EBO) equipment and operations. In North America, the regulation now is concentrated on railroad equipment and operations. Rail transit vehicles (LRVs primarily) are designed to interact with roadway vehicular traffic or each other. Railroad cars are designed to interact with other railroad objects equal in weight and bulk.

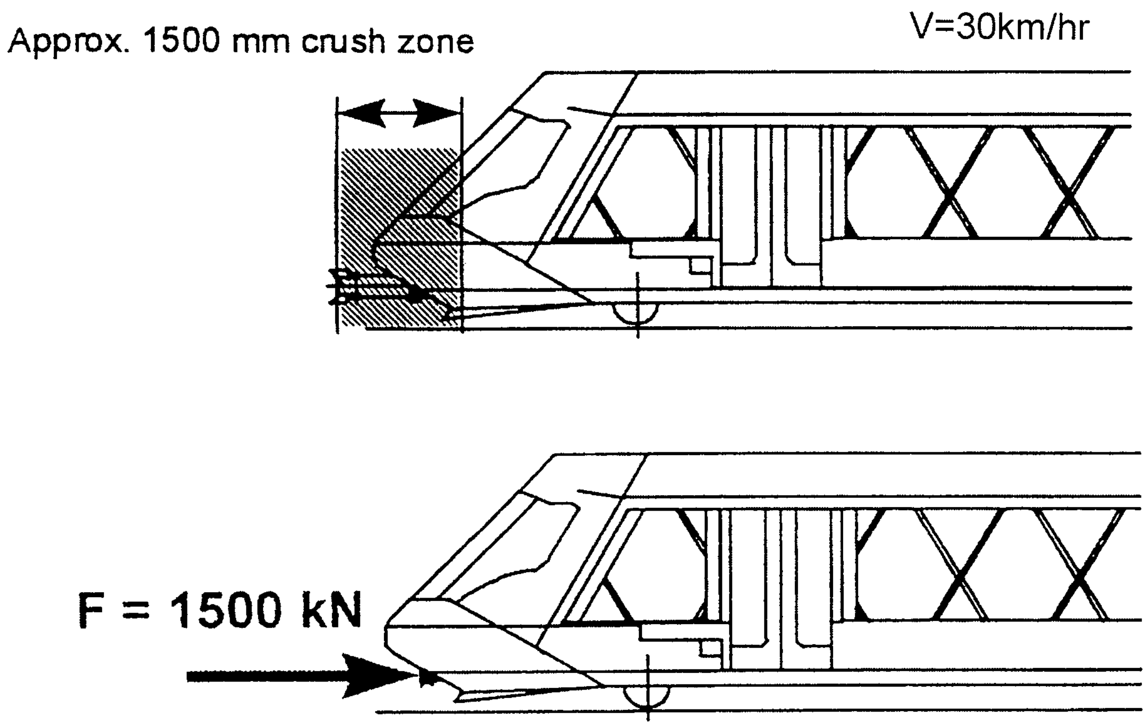
Figure 9-1 shows an example of combined active and passive measures, though not in sufficient quantity to meet current FRA compliance requirements. What is not shown are the passive measures that are included in the interior design of the cars. These include impact attenuators on interior surfaces and appurtenances which have a minor affect on car weight and performance, but diminish risk of injury and fatality to car occupants. More subtle in appearance is the use of structural members for appearance and strength of the car. At least two contemporary DMU car designs use diagonal members in a truss-like arrangement to increase the longitudinal strength of the car. Also in these and other designs of light-weight DMUs are pilots, functional fascias, or simply "cow catchers" for deflecting objects on the track. These prevent derailments from overrides of foreign objects and perform the similar traditional pedestrian safety functions of vintage trolley fenders. As pointed out in Chapter 8, when Japanese subway cars are adapted to use at-grade tracks with grade crossings on interurban and commuter railroad lines, metal pilots are added below the sills at car ends. To the extent that these interior and subtle exterior physical measures can be integrated into the car design without weight penalty, the crash avoidance and crashworthiness characteristics of the cars can be reconciled within a single car design.

b. How should this joint use research be applied as parallel research is advancing?

By adapting and recommending use of the risk analysis technique, this research is supportive of and in parallel with the other efforts in quest of safer and more productive rail passenger systems. These other efforts include:

- APTA's Passenger Rail Equipment Safety Standards Committee (PRESS)
- FRA jointly sponsored research, demonstration and testing of Positive Train Separation (PTS) and Positive Train Control (PTC) at the Pueblo Test Track and in various locations (IL, WA, PA and elsewhere)

Modern Light DMU Passive Safety Measures - Figure 9-1



Courtesy SLM Sulzer, now Adtranz

- APTA-sponsored Commuter Rail Safety Management Program and Rail Transit System Safety Program Plans (RTSSPP) and Rail Safety Audit Program (RSAP)
- FRA's Safety Assurance and Compliance Program
- FRA's Rail Safety Act reauthorization in FY 1998
- Developing state oversight of state (rail transit) system safety program standard.
- Federal reauthorization of the Transportation Legislation (TEA-21) including provisions for new starts and continuance of the MIS process
- Monitoring overseas innovations in safety, operating practices, car design, train control technology, and regulatory reform
- State initiation for expanding and enhancing state safety oversight efforts, which provide a quasiregulatory framework for non-FRA-covered systems

c. What cultural, institutional, and social conditions will influence joint use decisions and create environments hostile or advantageous to joint use?

The Pacific Rim and European examples of joint use cited in this report demonstrate that shared track can exist in varied cultural, institutional, and social climates.

Shared track practices are being expanded and refined overseas through an evolutionary succession of institutional reform, research, planning and risk studies, system design, and joint venture. Research in preparation of this report discloses that joint use is not achieved through any single document, person, or action. Changes in institutions, business, and technology create a regulatory environment more conducive to sharing of facilities. These changes are epitomized by:

- privatization,
- breakup of national transportation monopolies (and formation of new enterprises),
- federal/state/local changing roles,
- creation of EU in western Europe,
- restructuring of transportation institutions,
- advanced state-of-the-art communications and train control technologies,
- deregulation in some sectors,
- inducements for non-traditional business partnerships, and
- adopting of business practices in public transport.

Absent these types of changes and environment in North America, shared track will likely continue to be confined to a few temporally separated examples.

Under existing FRA regulations, the burden would rest with the waiver applicant to prove that risk has been diminished to tolerant levels *or that it never existed in sufficient magnitude to imperil public safety*. This process would not depart from the current waiver application requirements (CFR 238.7).

9.3 CONTEXT OF FINDINGS AND CONCLUSIONS

During the course of performing this research, a variety of informal views were expressed on the issues raised by joint use. They generally fell into two categories, *pro* and *con*:

For:

1. Joint use is feasible, if fail-safe train control and separation systems are developed.
2. Regulatory constraints on joint use in North America must be reexamined and reformed.

3. In spite of the cultural differences, shared track like Karlsruhe, and reciprocal running as in Japan, can be applied here, with proper controls.
4. "If they can do it over there, we can do it here."
5. Risk assessment can be used to justify joint use.
6. Mitigations can reduce any risk to tolerable levels.

Against:

- Nothing more than shared track by temporal separation will ever be permitted in the U.S.
- None of the overseas experience can be applied in North America because our railroads, operations, and urban development are different.
- North American regulators, transit, and railroad operators will never tolerate joint use because prevailing attitudes and institutional climate abhor shared track practices.
- Shared tracks by such disparate rolling stock as railroads and rail transit constitute an unsafe condition that can never be resolved in North America.
- Insurance and legal liabilities prevent any meaningful joint use in the U.S.
- Political and regulatory methodology in the U.S. often precludes any approach not based on evolutionary changes to existing railroad safety regulations.

The investigators on the research team conclude that this study will not resolve the opposing views listed above to the extent that Federally sanctioned joint use operations will happen or joint use will be prohibited forever in North America. Some observers may have expected such a decisive "go, no-go" pronouncement as a result of this research.

The expectation is that, as a result of this study, joint use and its application will continue to be treated as a potential viable transportation option, though joint use will not prove feasible in all applications. This conclusion is expressed because the research disclosed no reason for suggesting absolute joint use prohibitions nor concluding it should be dismissed without further research as a matter of national policy. A process is evolving which, at maturity, will provide tools to evaluate risk and apply other factors to make case-by-case decisions on applications of joint use. While the analysis tools may be applied locally, the *ultimate investment and operational decisions on joint use will be the result of fitting the analysis results upon state and Federal regulatory templates, as done overseas.*

Shared track can potentially occur where business advantages overcome the liabilities of shared risk and responsibility. Co-mingled joint use track arrangements could exhibit advantages such as: shorter implementation, lower capital costs, and in the cases of substituting rail transit for railroad passenger service, reduced operating costs. Cooperative joint use cannot easily happen where one of the partners is reluctant to participate. All public transit and participating rail carriers (public and private) would have to benefit from a joint use agreement.

While joint use risk was marginally higher than separated operations, overseas data and risk analysis demonstrates that applying mitigation reduces joint use risk below that of separate operations. Risk therefore can be quantified, managed, and diminished by those assuming the risk at the local or metropolitan level.

Is joint use on shared track, a potential transportation alternative in the context of MIS-type alternative studies and other new start ventures? To date, joint use has tended to be dismissed by the fatal flaw approach, citing Federal regulations without the benefit of risk or cost assessments in individual local applications. As described earlier, risk assessments are performed with Federal oversight in proposed shared joint freight/high speed passenger *railroad* facilities such as Northeast Corridor and FOX (Florida Overland eXpress). Risk analysis is also being employed by Utah Transit Authority for Salt Lake City temporal joint use and in south New Jersey. Risk assessment used in this way is acknowledged by FRA and rail operators to be a tool in demonstrating that public safety will not be violated by *certain types* of railroad *joint* operations in the United States now. It is only applied currently:

1. between different types of railroads,
2. temporally between rail transit and railroads, and
3. for temporary waivers.

Risk analysis is not routinely applied to ***permanent*** *joint use arrangements between rail transit and railroad vehicles in North America.*

To provide the tools to evaluate potential joint use risks, this research team has drafted a Risk Assessment "Guide" (Chapter 6 in this report) which could be applied at local option at the metropolitan level and in individual corridor studies. The purpose of this approach is not to undermine U.S. safety regulations. On the contrary, it is intended to quantify where potential high risk and unsafe conditions would accompany joint use – and where those unsafe conditions would exist.

This research is only one in a series of simultaneously advancing efforts described earlier and below affecting joint use and related operating practice outcomes. It has been prepared with recognition of these companion efforts at the state, Federal and private sectors, and it is intended to fit within the flow of the conclusions and findings that they produce.

Domestic North American efforts include:

- Activities of trade, research, and ad hoc professional groups, such as the Passenger Rail Equipment Safety Standards (PRESS) program.
- Formulating new or reforming existing regulations and rulemaking by FRA and various overseas rail ministries (in the latter case establishing precedents and sharing experience).
- Emerging state oversight of rail transit and implementation of state-developed System Safety Program Plan Standards,
- Advancement of new train control technologies (PTC, PTS) and their application in a variety of operating environments.
- Clamor for rail new starts by several North American metropolitan areas and local jurisdictions.
- Rail mergers, disposal of branch lines to new and traditional short line operators (who tend to be more responsive to local needs and demonstrate greater willingness to blend passenger and freight trains where it produces additional revenue).
- Increase in popularity of public private partnerships, DBOM, turnkey, and "third sector" type enterprises.
- Creation of regional rail transit entities/systems overseas, and Regional Railroads in North America.

Overseas efforts include:

- Further overseas applications of joint use in varied environments and circumstances.
- Refinement in the state of the art in a variety of joint use applications and growing experience about the characteristics and performance of shared track operations.
- Growing experience and time series data on joint use safety and risk.
- Overseas division of former nationalized railways into track/ infrastructure, passenger operations, freight operations and rolling stock into separate private railroad businesses.
- Privatization of rail systems and functions overseas (to an institutional railroad environment closer to that of the U.S.).

None of these activities alone will resolve joint use controversy. None to date have revealed a single device or practice that radically alters joint use risk or viability. All of these activities together could influence joint use decision making and outcomes.

9.4 OTHER LESSONS LEARNED

The nature of joint use is revealed through descriptions of current operations, route, and areas served. There is a broad diversity of shared track arrangements between different rail modes encountered in this research. This diversity indicates three types of processes at work:

- Incremental application of joint use practice spawns variants (in Karlsruhe, there are five types of joint use operation).
- Case-by-case local innovation, rather than general "wisdom," applied uniformly to joint use.
- A federal regulatory oversight, with sufficient latitude to permit state and local innovation.

None of the overseas experience described earlier offers a single optimal model for application in North America. *Elements* of each of the joint use examples profiled in Chapters 7 and 8 demonstrate experience that can be applied very selectively, and on a case-by-case basis, though fewer rail transit environments exist in North America.

9.4.1 Institutional Lessons

One characteristic common to both overseas continents is the proliferation of private and third sector-type railways. In North America, a comparable condition is the creation of short line and regional (freight) railroads and their recreational and dinner train affiliates. In Germany, these type of new rail enterprises fall into the regional, or Stadtbahn, category. In Japan, they are more commonly considered "interurbans," or third sector short lines.

Since the disappearance of the interurban railway in North America, there is no common term for these systems, though TRB paper sessions have been organized around the theme of "Regional Railways." Equivalent operating systems in the U.S. would be exemplified by St. Louis LRT or San Francisco's BARTD. Note that in the U.S., "regional rail" has been applied to light rail, rail rapid transit, and commuter railroad systems that perform similar operating functions, but to varying degrees.

Because shared track can be accomplished far more rapidly than building all-new parallel track, the evolution of rail systems under such an arrangement compresses time (and budgets). In Karlsruhe, the regional LRT-based system had a 25-year gestation, but once the precedents and common interests were established and once the practices were proven feasible on the interurbans, the full railroad/LRT shared track innovations came in rapid succession. In the past five years, six railroad corridors have been converted to regional Stadtbahn/LRT service totaling over 120 route km (75 route miles). Ridership growth over the previous railroad service ranges from 100% to 470% (the latter on the Karlsruhe - Bretten/Gölhausen S4 service).

In Karlsruhe, shared track is deployed in several ways, not all of which can be applied in North America. One of the principal advantages of German light rail is derived from converting regional DBAG railroad-based services to LRT-based Stadtbahn services. There are few direct equivalents for these types of passenger railroad service in the U.S., most of those that existed were discontinued or replaced by bus. The advantages of one-man operation, of the lower operating cost per km (DM5 per LRV km vs. DM12- DM17 per train km), lower energy cost (savings of DM 18,000 per train annually), and time savings (LRVs @ 90km/h. top speed) save six minutes on a 32 km line compared to railroad train (@ 120 km/h) and other potential savings on crews, equipment, and energy do not apply in North America, except as LRT might favorably compare to regional bus services.

The Luxembourg case study is somewhat more applicable. While five rail BTB-2002 corridors do provide a regional rail network around Luxembourg, the region is heavily dependent on regional buses, and the insufficient capacity of city streets to handle regional and local buses combined was a prime motivation to convert to LRT.

These are described as "operations" above, but they are also physical and real estate "properties" that are jointly managed. Initially, ownership is important in establishing shared track rules and practices, but over time, as tenant and host become more acclimated to joint operation, the ownership distinctions become less defined as shared risk, shared benefits, standardization, and common interest prevail. The most dramatic example of full maturation of shared track is when one of the partners adopts the rolling stock standard of the other as a business, marketing, or financial policy.

As pointed out in Chapter 8, *the six successor railroads to JNR have purchased and operate rail buses in joint service with their other railroad-size freight and passenger rolling stock.* In Germany (and Switzerland), *railroads purchase rail buses and LRVs, operating them on their indigenous railroad tracks* in mixed traffic for reasons of economy and business. A specific example is at Karlsruhe, where Deutsche Bahn AG (DBAG) purchased identical (to the LRT operator) light rail rolling stock to substitute for more costly railroad DMUs and locomotive-hauled passenger trains operating on its own railroad lines.

This practice is the ultimate acknowledgment by a railroad that shared track *and integrated operations* can work. Because post-1981 railroad passenger and freight businesses are separated in the U.S., these types of applications are limited. Selling the railroad property to a transit operator in exchange for exclusive trackage rights for railroad freight service is another acknowledgment.

In Japan, a broad range of joint use arrangements has unintentionally promoted standardization of equipment, driven by a shared infrastructure. As rail rolling stock is retired, the replacement equipment is specified to a more uniform standard, in some cases to go beyond joint or reciprocal running to actual pooling of equipment. Examples are cited in Chapter 8.

9.4.2 Lessons on Costs and Cost Savings

Related to the safety issue are cost and cost savings. Can a balance be achieved between joint use benefits (better service, more new starts and lower costs) and the potential risk and liability associated with shared track? While it is always difficult to weigh injury and fatalities with convenience and cost savings, the cost of litigation and claims tend to drive potential North American transportation liability decisions rather than the benefits to users: "If we do this, will we get sued?" Recognizing the difficulty of costly litigation in North America, and acknowledging that locally performed risk analysis can begin to estimate cost risk specifically on a case-by-case basis, the following dramatic examples begin to quantify cost benefits of joint use, at no sacrifice of safety.

The data in Table 8-4 reveal rapid transit in twelve Japanese metropolitan areas. Total rapid transit route miles are 406 miles (654 km.). Rapid transit service with joint use totals 789 miles (1269 km.) The difference in these two numbers (383 route miles or 615 km.) represents the increase in rapid transit service route miles coverage as a result of joint use or reciprocal running. The route miles due to reciprocal running were increased by 94%. An additional benefit is reducing mandatory transfers between carriers with end-to-end matching rail services. Another is the capital cost savings resulting from avoiding or minimizing costly subway construction. With the high density of Japanese metropolitan areas, such rapid transit expansion would not take place on the surface and in any case would be extremely disruptive to the social, economic, and natural environment.

If one conservatively estimates cost of double track rapid transit route miles in subway at $100 million a mile, the gross cost savings nationally is $32.8 billion! These savings are diminished by the need for new rolling stock and critical track connections and other costs associated with the integration of two or more rail systems. These costs, however, are relatively modest, and can be phased over time. The cost estimate is, of course, an exercise, because that amount of money would not likely have been spent and that expansion of route miles would not have happened using tunnel construction.

A similar capital cost savings estimate for one European metropolitan area produces more modest, but significant savings. It is estimated that Karlsruhe gained 127 route miles as a result of joint running with AVB, DBAG, and SWEG railroads. A conservative capital cost estimate for LRT route miles of double track on reserved right-of-way is $20 million/mile. Applying that estimate to Karlsruhe VBK/AVB network results in a gross savings, based on 127 route miles, of $2.5 billion. The relatively modest capital costs of integrating the two systems through track connections, compliant rolling stock, and infrastructure, should be subtracted from the estimated benefit savings. As in the Japanese experience above, these rail lines would never be justified as separate facilities at these costs. Most of these "new starts" overlay existing or former obsolete services.

The lesson suggested from both preceding paragraphs is that joint use is not only a more cost-effective way of preserving and expanding existing rail transit systems and initiating "rail transit new starts," but more importantly it enables more new starts to begin using finite funding resources and lowers the cost feasibility threshold for rail new starts that would otherwise be too costly.

Other potential capital cost savings arising from shared track are: standardization of equipment, pooling of rolling stock (because of higher performance LRVs, Karlsruhe saves a train consist [3 LRVs vs. 4 railroad consists]), joint purchasing, and selective pooling and sharing of maintenance and operating facilities. Cooperation breeds other cooperation and savings. Uniform or universal fare collection systems are among the costeffective cooperative ventures accompanying shared track.

Operating cost savings from resource conservation includes reducing of energy consumption. Karlsruhe claims DM18,000 ($10,000) annually per train and labor costs by substituting smaller transit crews for railroad crews. The latter labor savings translates into a minimum of halving train mile costs or DM 5.5/km for LRVs and DM 12-17/km for railroad consists (Ludwig). The initial joint use lines in Karlsruhe perform at an 85% cost recovery ratio. Prior to the last downturn in steel prices, Japan's Sanriku Ry. third sector railbus operation showed a 99% operating cost recovery.

9.4.3 Lessons Applying Joint Use to North America

During the course of conducting this research, discussions with several advocates of rail transit disclosed the view that because railroads and light rail share common track "over there," that alone proves that joint track use can be accomplished in North America. This research does not support that premise. It also does not try to "make a case" based exclusively on European or Pacific Rim experience. Operating and social conditions are different in North America, which casts doubt on the direct application of overseas practices. This report does, however, consider what can be learned and transferred to improve and expand North American transit practices.

Recalling Chapters 1-4 and the key issues identified in Chapter 5, which issues (and accompanying measurables/policy) are applicable to transferring overseas joint use experience to North America?

- Regulation: Overseas joint use safety experience vs. U.S. non-joint use experience and before/after increased service benefits/costs compared to risk. Insufficient data on both sides thwarts direct comparisons. Risk analysis techniques are compatible.

- Operations: Specific overseas operating practices can be applied to risk mitigation.

- Physical Overseas Plant: Track, signaling, and train control systems are being applied now.

- Vehicles/Rail Cars: Crashworthiness measures are applicable to North America. Most passenger rail transit car design is non-domestic.

Karlsruhe is held up as the ideal model of joint use, yet some prevailing myths surround Karlsruhe's extensive joint use system. Misunderstandings include:

- Karlsruhe overcame obstacles to joint use in a short time.
- It was the first to implement joint use.
- The regulatory and institutional obstacles facing the Karlsruhe region in implementing joint use practices were different, and less difficult, than those in North America.
- Once shared track had been achieved at Karlsruhe, expanding the system meant merely replicating the experience with the initial line.
- Because they accomplished joint use in Germany, North America, can accomplish it here the same way.
- Some feature(s) of the Karlsruhe circumstances or key operating discipline, if applied here in the U.S., would instantly ensure acceptance and success for shared track arrangements in North America.

Karlsruhe may not be the first operator to practice joint use (note earlier references to historical examples), but it is currently the most widely known internationally by rail transit practitioners. It is distinctive because it pioneered applying extensive and varied joint use practices, grew its system incrementally, and achieved success within two and a half decades. Karlsruhe provides multiple case studies in applying shared track use in a variety of social, economic, and geographic environments.

Related to the myths listed above, several characteristics of Karlsruhe are instructive to consider for North American application and will provide the structure of this profile of Karlsruhe's shared track experience:

- *Dynamic and persistent leadership* by a strong and skilled personality (Dieter Ludwig, General Manager of the system) was important to achieving joint use. Domestic LRT success stories also reveal "champions."

- *The system began very modestly* by first absorbing and then converting a failing meter gauge interurban Albtalbahn (AVB), which provided joint passenger and limited rail freight services.

- *Each successive shared track addition to the system was an incremental achievement* in joint use practice because it was different and more venturesome than previous additions. Each increment increased system complexity, bringing rail transit and railroads and their institutions into greater intimacy. The current level of integration and coordination was achieved incrementally, "raising the bar" at each step.

- *Participating joint-use institutions reached agreement on shared track specifics when it became in their joint interest to do so.*

- *Shared track credibility came with more and intensified joint use experience.* Once the advantages of joint use were confirmed and the benefits distributed among all partners, subsequent joint use proposals were more readily accepted.

- *Joint use was accompanied by other changes* in social, economic, and institutional structure which happened to be supportive. Alternatively, joint use requires or is triggered by a desire to reform and improve public transportation of all modes. Most notable among these was the shifting of local and regional transit financing and decisionmaking down to the Lande, or provincial level.

- Major differences exist between German and North American railway equipment and practices, but *institutional concerns between rail transit and railroad operators and their respective regulators are similar.*

9.4.4 Overseas National Policies

Switzerland and Germany have pioneered in joint use applications of various types and circumstances. France and the Benelux countries are planning similar joint use applications.

National polices in Switzerland and Germany can be characterized as:

- Encouraging regionalism of railways, through establishment of local organizations for planning, financing, and managing such projects (usually cast-offs of the national railway system).

- Privatizing elements of the national railroad system.

- Frequently accompanying privatization is the division of national railway organizations into separate businesses: infrastructure ownership and maintenance, rolling stock ownership, freight and passenger operation ownerships, and real estate managements.

- Establishing a body of law under which private companies can compete for operating contracts for a variety of rail services.

- A set of federal regulations governing tram, rail transit, and railroad operations/physical standards *separately* (BOStrab, EBO, and DBAG).

- EC mandates and directives which overlay (and in some cases compel) federal regulations and institutional reform.

- The ability to evaluate new regulatory concepts politically and to apply risk analysis to a high degree in developing new regulations.

- Integrating (or retaining) freight and passenger operations under common management.

The Netherlands is somewhat an exception because, as described in Chapter 7, they are grouping three adjacent but separate metropolitan areas that may grow into a single, common LRT-based system to function among and within three cities. Their national planning group (Railned) is charged with the responsibility for establishing basic standards and resolving technical compatibility issues between the national railroad (NS) and among the city LRT systems.

Railned's policy on risk is pertinent to North American circumstances and worth quoting from the March, 1998 International Railway Journal.

> "Railned has stipulated that dual mode operation should pose a greater risk than for pure heavy rail operation. Any extra risks resulting from dual mode operation (additional service [train density], different operating speeds, crashworthiness, braking potential, train detection, change of derailment) must be compensated by extra safety elsewhere. Risks are assessed in accident/train km and the number of injuries to passengers and staff. Railned will be making careful assessment of crashworthiness both with other rail vehicles and broadside with road vehicles."

A major difference from the Netherlands circumstances is that U.S. light rail cities are far enough apart as to preclude any concerns about compatibility between LRT systems. The issue of compatibility between rail transit and railroads remains.

9.4.5 Contrasting Pacific Rim and European Joint Use, and Applications to North America

Major differences exist in the Pacific Rim and European arrangements which have implications for North American application:

- Japan has no common examples of joint use between light rail and main line railways. Like the U.S., but unlike Germany, Japan motorized (with buses) substantial portions of its former street railway network. As G. Thompson points out, "Don't grope for something that does not exist. There are no Pacific Rim Karlsruhes." There are, however, many Japanese interurban electric and diesel propelled (railbus or DMU) operations which integrate with railroads and rapid transit. In a sense, the interurban railway is the agent for joint use in Japan, while light rail is the agent for joint use in Europe.

- Three major types of joint use have evolved in Germany and are spreading elsewhere in Western Europe:

  - Regional railways based on light rail and railroad (Category 1 and 2) DMU technologies on railroad branch line service and venturing onto main line railroads. (Dürener Kreisebahn - DKB)
  - Stadtbahn railways based on light rail technology integrating service between streetcar/tram and railroad branch and main lines. (Karlsruhe AVB)
  - Metros and Pre Metros where light rail and heavy rail rapid transit are integrated with the objectives of extending the reach of metro service cheaply and/or converting light rail to heavy rail in phases.

- Two types of generic shared track exist in Japan. These two types do not lend themselves to classifying relative to rail modes or institutions as shown in the German example above. The resulting arrangement between two or more rail carriers does not form separate railways (though third sector railways are formed to accomplish portions of shared track arrangement).

  - Joint Use between railroad passenger, interurbans, and rapid transit railways in urban areas. One railway runs over another's track beyond its customary terminal/ ownership, with the host/ tenant relationship not being reversible.
  - Reciprocal Running (a subset of joint use) between diesel interurbans, railbuses, and DMUs and the national railroad network represented by the Japan Rail group of railroads. Two or more railways of compatible standards, joined end to end, run over each other's tracks in an integrated service. These tend to be suburban or rural in nature. Another subset of joint use is reciprocal running between rapid transit, light rail, railroad, and interurban. These tend to exist and flourish in urban areas.

- Another major difference between Europan and Pacific Rim experience is that Japan's ambitious rail construction programs and plans described in Chapter 8 include significant *new construction built in anticipation of future joint use.* In Western Europe, joint uses are largely reclamations of *existing* abandoned, disused, or underutilized capacity on the railroad system *in response to current demand.* Purpose-built joint use does exist in some European light rail/pre metro and metros as a temporary means of phased expanding of heavy rail. New construction consists of key connections between metro, LRT, and railroad networks, rather than all-new lines purpose built with eventual joint use in mind.

- Both of these joint use philosophies are currently rare among North

American transit governing boards. Rail transit and people mover infrastructure is built with little regard for potential interchange or, in some cases, to exclude any integration with other modes or carriers.

9.5 CONCLUSIONS

Risk analysis quantifies and foreign experience indicates that:

- Risks can be quantified according to circumstance and situation.
- Joint use risk could be brought within and managed at acceptable limits, although how that risk would be shared among the railroad and transit entities would probably be the subject of considerable negotiation.
- Risk can be further reduced by applying mitigation measures.
- Decisions on joint use can be entrusted to those who assume legal and financial risk, with guidance by basic national standards.
- Selective application of joint use practice can be made on a case-by-case basis and with the cooperation of the freight and passenger rail partners using the Screening Matrix (See Table 9-1).
- Additional research is required to fully translate and understand the German literature, to interpret its findings, and to routinely collect new overseas joint use and risk analysis studies as they are released. On-site inspection of Karlsruhe to understand joint use practice and opportunities is a logical extension of this research.
- There is a dearth of accident data and history on which to base risk assessments. While this meager data reveals increasingly safer rail transit and railroads, it also retards the ability to quantify risk.

While there is insufficient joint-use accident experience at this time to quantify risk conclusively, probabilities of collisions on low-density freight lines appear to be sufficiently small to consider enabling local decision makers to determine risk and apply shared track practices accordingly.

Application of further physical and operating measures would further mitigate risk. In Germany, this is done by applying a more stringent BOStrab (streetcar) regulation to offset risk exposure caused by exceeding an EBO railway standard. Put another way, the active performance (deceleration capabilities) of an LRV offsets the lack of passive (crash resistance) capabilities of that same LRV. In Europe, enhanced stopping performance is achieved by redundant braking systems, including regenerative braking on LRVs and multiple retarders on Category 2 and 3 DMUs.

In North America, this issue has been debated as crashworthiness vs. crash avoidance. Regrettably, these objectives are seldom complementary, since one may be achieved, but at the expense of the other. A Volpe Center study (Tyrell, Severson et al., "Evaluation of Cab, Car Crashworthiness Design Modifications," March, 1997) claims that increasing the crush zone at car ends does not exact a significant weight penalty and thereby reduction in car braking performance related to weight.

The motivations for instituting joint use, where it is practiced, are institutional and economic. In Europe and the Pacific Rim, shared track is not considered in itself a reform. It is considered a device for implementing reforms that are motivated outside the transport sector. It is considered inseparable from fundamental economic and development policies and initiatives. The reorganization and privatization of national railroad systems and related activities which trickle down to the branch lines exemplifies this massive overhaul of the system. In this context, the advantages and shortcomings of joint use are weighed in light of achieving national policies and state/local objectives. These advantages include:

- Consistent with national transport (or in the U.S., Class 1 railroad) policy to shed local branch lines whose continuance cannot be economically justified by a large railroad.
- Transfer to local authority (in the U.S., a regional or short line carrier) resulting in less expensive train operation, as exemplified by third sector railway efficiencies in the Pacific Rim and bidding of public transport to contractors elsewhere.
- Current "hold harmless" and other legal and liability provisions in joint use agreements between U.S. freight and commuter railroads have established relationships and precedents adverse to shared track of other types.

This research alone cannot resolve the feasibility issues of joint use introduction in North America. Had there been a richer trove of rail accident and incident data based on actual joint-use operation, perhaps a more convincing case could be made that joint-use risk is tolerable on a national or generic level.

Research disclosed no extraordinary joint use accident experience abroad which merited coverage in the professional rail trade press, nor did any surface from the direct overseas contacts. Accidents between LRVs and railroad trains were found in the risk analysis data (Appendix N). We found no case where joint use was revoked for safety, scandal or "disgrace" (in Japan) associated with an accident or other reasons of risk associated with joint use. The law of averages dictates that such an incident will occur, but plainly stated, after a decade of experience, some in very heavy rail traffic corridors, there is no evidence that shared use of track, as applied, inherently causes incidents any more than does other types of shared tracks by multiple train movements.

In dealing with risk, Chapter 6 presents data that demonstrates that rail transit and railroad passenger operations (separately) perform safely relative to other modes of travel. "Railroad (and) transit accidents, while rare, (are) spectacular, engender headlines . . . followed by government investigation . . . but it confuses the understanding on just how (risky) transit may be" (E. Tennyson, "Rail Transit Safety Analysis", TRB, 1998).

Clearly, there are circumstances under which mixed operations by certain types of high speed, high volume rail modes or vehicles constitute an unacceptable risk to the public. There are other low volume, low speed co-mingled conditions in which the risk is minimized or negligible. All of this range of circumstances is currently treated similarly in North America. The mission of this work was to determine if there is a way to differentiate between the risk extremes by applying overseas experience and quantified risk analysis.

Judgments are still made within a regulatory framework. Standards are still applied. Operating discipline is still maintained. There are, however, several fundamental differences between the approach being considered in this report and what is currently practiced. MPOs, State regulators and independent DBOM consortia can be the vehicles of change as implementors as follows:

- Develop a more user-friendly planning process in which costs, risks, impacts, and benefits can be considered together in potential joint use applications. The stakeholders will make decisions on whether joint use benefits to the immediate local public and participants offset the calculated magnitude of risk. This approach is consistent with Federal policy for decades through the local/regional 3-C, Alternatives Analysis, and MIS processes, where the planning analysis and design are performed locally and local choice is exercised under Federal guidelines and scrutiny, but without precluding local prerogatives. Similarly, local decision-making on joint use, integrated into the planning process, could be conducted under regulatory scrutiny in order to preclude any potentially flawed or inappropriate analysis.

- Apply the Screening Matrix (at the end of this chapter) and risk analysis process described in Chapter 6 in a multi-step process. Include this process within the MIS or similar planning processes in selecting optimal rail transit alternatives (only if joint use alternatives apply and do not create an undue burden on local authorities).

- Joint ventures between various business (transportation, development, etc.) and government interests are continuing and should be encouraged. These ventures offer a climate in which joint use can flourish. Joint use of tracks is only one aspect of joint venture. The Pacific Rim "Third Sector" experience demonstrates that the right combination of complementary business interests encourages joint use, joint venture, and joint opportunities. Currently Design, Build, Operate, and Maintain (DBOM) popularity brings diverse transportation and non-transportation interests together in a common forum. States like New Jersey have passed legislation encouraging these partnerships to expedite transport projects formerly the sole domain of the public sector. Reintroducing the private sector to public transportation and sustaining their existing interest in railroad transportation creates a business climate with common interests that can cross modal boundaries.

- A stronger relationship needs to be built between other rail safety research, technology ventures, and shared track research. Rather than treating these as separate research efforts, they can complement one another and be better integrated.

  An example of such complementary efforts is that between risk analysis and Federal and industry cooperative ventures with railroads on Advanced Train Control as done now by FRA.

- Case-by-case evaluation, within the context of the current federal and state regulatory environment would continue, but would allow for more input in the decision-making process at the metropolitan level. The conventional planning process and institutions for this cooperative process with Federal oversight is already in place through Metropolitan Planning Organizations (MPOs). The MPO could advance a study agenda and provide a forum for the public, the transit operator(s), the railroad(s), and the federal and state interests to analyze and debate joint use issues.

- Continuously improve and refine Risk Assessment tools to support local decision-makers. The risk assessment technique will improve as the safety database grows and joint use experience broadens. The Risk Analysis guidance in Chapter 6 and Screening Matrix are two such tools. Collecting and compiling data in support of these tools is a priority.

- Continue to monitor overseas experience. While there are no direct U.S. equivalents of Karlsruhe nor U.S. places where Japanese-type reciprocal running can now be directly applied, these and other overseas precedents are instructive in forming any unique U.S. type of shared track arrangements. Overseas pioneering in "rail new starts" and enhanced existing services will benefit domestic practitioners by avoiding "their" mistakes. Directly equivalent conditions or circumstances need not exist to learn from the experience of others.

- In a private-sector joint venture, the fundamental decision to advance may be made cooperatively at the metropolitan level, but the execution would be left to the private operators and risk takers, under the mantle of basic regulatory guidelines.

These conclusions are consistent and supportive of current domestic regulatory authority. Nothing in this report suggests a policy contrary to the current regulation, which is on a case-by-case basis and by-exception regulation of joint use, as described in earlier chapters. It is concluded, however, that the way in which decisions are made, who makes them, and the tools used to decide joint use practices may need to be reconsidered. A principal conclusion is therefore offered.

9.6 PRINCIPAL CONCLUSION

This research does not result in a specific recommendation on the viability of joint use in North American railroads and rail transit systems, other than joint use merits consideration. That decision is more properly made elsewhere, where the risks are assessed and assumed. The research, however, suggests a principal conclusion to apply a technique whereby cooperative judgments can be made, whether or not to share track. It is concluded that the decision process be presided over by a number of interests coming together for cooperative deliberation. Those interests include at a minimum:

- Rail Transit operator(s).

- Railroad operator(s).

- Railroad owner (when it is different from the above).

- Federal regulatory agencies (if applicable).

- State(s) agency(ies) responsible for oversight of rail transit and operator Rail Transit Safety Program Plans, along with Federal policy framework and regulatory standards.

- Private Sector Joint Venture, Turnkey, or DBOM Partners and their prime consultant (if applicable).

- Agencies or organizations sponsoring any MIS or alternatives analysis and their prime consultant (if applicable).

Risk analysis is currently not required in the rail facility planning process. It is selectively used, however, to evaluate very specific parts of a proposed system which are suspected to be risky. San Diego did not employ it in its initial joint use between LRT and railroad.

Salt Lake City is using risk analysis to assess LRV/freight train temporal separation only. Seattle is using it for a portion of its proposed commuter rail joint use (with freight). South New Jersey is using it in its Trenton-Camden DBOM using non-compliant DMUs. Though risk analysis may not be used uniformly in new starts or MIS planning processes, it is used in railroad major investment planning and demonstrations. The Northeast Corridor, Florida FOx and non-compliant DMU North American new starts provide examples. FRA will likely require risk analysis as a condition to granting waivers or exceptions.

No new planning or major (public) investment process is suggested as part of this research. Existing MIS or alternatives analysis framework can apply through the MPOs for certifying and making projects eligible for public funding. Competitive turnkey or DBOM procurement processes, to the extent that they are required for Federal funding or environmental concurrence, also provide a safeguard for evaluating joint use options.

For rail new starts employing MIS or similar processes, joint use is vulnerable to be dismissed early in options screening because of the regulatory barrier to rail transit and railroad equipment on shared track. If joint use alternatives are eliminated as automatic fatal flaws, the following useful planning information would be precluded:

- Understanding and quantifying the risk probabilities of the proposed joint operation.

- Knowing if such a joint operation could be mitigated down to an acceptable diminished risk which could be otherwise feasible for a new rail start.

- Estimating capital cost comparisons of an all-new alignment vs. adapting the existing one.

- Assessing the environmental, social, and economic impacts of a new parallel alignment in contrast to proposed joint use of an existing alignment.

- Knowing if the risk and other joint-use factors offset the added cost and disruption of acquiring a new alignment and installing improvements on it.

A railroad line in a joint-use alternative might have a range of from less than two to more than 24 daily freight train movements, but the analysis never advances to the point of determining feasibility under various traffic intensities and the risks each entail.

The following steps in determining joint use feasibility are suggested:

Step #1. This research team devised a Preliminary Screening Matrix for Joint Use Feasibility and application of Risk Assessment (Table 9-1). It is intended as a guide to determine when to apply risk analysis. It is not intended to prescribe the circumstances where joint use between rail transit and railroads is viable.

Step #2. If the inquiry passes Step #1, a risk assessment should be considered, if there are joint use options under serious consideration. The Risk Assessment Guide in Chapter 6 is designed for novices in risk assessment, to make a determination if a joint use alternative is appropriate for consideration in an alternatives analysis, MIS, or other screening technique. Other risk assessment guidance, such as the system described in Military Standard 882-C, is also available.

Step #3. Apply the MIS or other alternative selection process. The shared track alternative or alternatives may still be rejected on technical or other feasibility measures when subjected to the conventional screening criteria. The opportunity thereby exists to assess joint use with other techniques for expedited and cost-effective new start implementation within the conventional planning process.

A value engineering exercise may be applied at this point as an option to confirm the validity of the selected alternative (whether joint use or not).

Note that these steps are suggested as options, not additional regulatory requirements.

As risk analysis techniques improve and the reservoir of safety data accumulates, the processes suggested by this research will gain more credence.

Table 9-1
Preliminary Screening Matrix for Joint Use Feasibility and Application of Risk Assessment

Freight and RR Service and Passenger RR for Columns 1-3	1	2	3	4	5	6
> 12 thru trains	RA	RA	RA	OK - RA	OK - RA	OK - RA
6 - 12 local/thru daily	RA	RA	RA	OK - RA	OK - DIS	OK - RA
2 - 6 local/thru daily	RA	RA	RA	OK - DIS	OK	OK - DIS
1 - 2 daily local	Time window only RA	Time windows RA	Time windows RA	OK	OK	OK - DIS
< 1 train daily or as needed	Time window potential	OK	OK	OK	OK	OK
None or night operations only (with full temporal separation)	OK	OK	OK	OK	OK	OK
Rail Transit Model Car Type	**Light Rail LRV** < 30 min. base headway	**Category #3 DMU** [DLRV] (in diesel mode) (in electric mode)	**Category #2 DMU** [DLRV]	**Category #1 DMU** [rail diesel car]	**Commuter Railroad EMU** or Loco. Hauled (LH)	**High Speed Intercity EMU/LH**
	(NON FRA COMPLIANT)			(FRA COMPLIANT)		

Notes:

- DIS = Discretionary Use of Risk Assessment
- RA = Risk Assessment should be considered
- Risk Assessment subject to local conditions, values and determinants
- Consider what mitigation of risk will permit upgrading joint use potential within each cell as ATC, PTC and PTS enable higher concentrations of train density